USER MANUAL

ACCESSORY 2E

4-Axis Expansion Board

3Ax-602805-xUxx

October 15, 2003

DELTA TAU
Data Systems, Inc.
NEW IDEAS IN MOTION ...

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OVERVIEW

The ACC-2E Axis Expansion Board provides two or four channels of PMAC2-style servo interface circuitry for UMAC-Turbo and Ultralite/MACRO Station controllers. The ACC-2E is part of the UMAC or MACRO Stack family of expansion cards and these accessory cards are designed to plug into an industrial 3U rack system. The information from these accessories is passed directly to either the UMAC or MACRO Station CPU via the high speed JEXP expansion bus.

Up to two ACC-2E boards can be connected to one UMAC, providing up to 8 channels of servo interface circuitry for either the UMAC-Turbo or UMAC-MACRO systems.

The ACC-2E board contains no processor; it has 1 highly integrated 4-channel PMAC2-style "Servo IC" with the buffering circuitry and connectors around them. The ACC-2E stacks into either the 3U Turbo PMAC or the MACRO CPU cards, and uses one slot in the rack.

The ACC-2E provides four channels of PMAC2-style digital servo interface through two 100-pin high-density JMACH connectors; breakout supported through PMAC2-style ACC-8 boards (sine-wave drives can be supported through ACC-8E). Up to two ACC-2E boards are permitted in a Compact MACRO Station configuration.

With ACC-2E option A, the on-board 4 channels of analog output, 4 sets of flag isolation, and PMAC(1)-style interface through 96-pin DIN connector. Pinout like PMAC(1)-VME; breakout supported through ACC-8D or ACC-8P with Option V cable.

Note

The ACC-2E was not designed to plug into the Delta Tau UBUS Systems

Features

The ACC-2E board can be used with any UMAC or MACRO Station CPU, interfacing through the stack JEXP connector.

The ACC-2E supports a wide variety of servo and stepper interfaces:

- Analog +/-10V velocity commands
- Analog +/-10V torque commands
- Sinusoidal analog +/-10V phase current commands
- Direct PWM phase current commands
- Pulse-and-direction commands

Power Requirements

5V	12V*	-12V*	other 24V etc.
750mA	400mA	400mA	N/A
* with option 1A			

CONNECTOR SUMMARY

ACC-2E Four-Axis Piggyback Board

J1: (JEXP_A) 40-pin header for connection to piggyback board(s)

J2: (JEXP_B) 40-pin header for connection to piggyback board(s)

J3: (JEXP_C) 28-pin header for connection to piggyback board(s)

J4: (JMACH1_DIG) 100-pin high-density connector for 2-axis servo connection (Channels 1 & 2) to PMAC2-style ACC-8x breakout boards or equivalent

J5: (JMACH2_DIG) 100-pin high-density connector for 2-axis servo connection (Channels 3 & 4) to PMAC2-style ACC-8x breakout boards or equivalent

P1: (JMACH_ANA) 96-pin DIN connector for servo connection to PMAC(1)-style ACC-8D/*P breakout boards or equivalent. Only present if Option A ordered.

TB1: (JWDO): 4-point terminal block for output of watchdog-timer hard-contact relay.

ACC-2E FOUR-AXIS PIGGYBACK BOARD JUMPERS

E1: Channel Select

Jump pins 1 and 2 to select board as Channels 1-4.
Jump pins 2 and 3 to select board as Channels 5-8

Note:

If two four-axis piggyback boards are used on a Compact MACRO Station, they must have different settings of this jumper.

E2: Handwheel Input Source Select

Remove jumper to permit handwheel encoder inputs on P1 B-row of this board.
Jump pins 1 and 2 to permit use of encoder inputs from 2-axis board.

E3: Serial ADC Data Source Select

Remove jumper to permit use of ADC serial inputs from 2-axis board.
Jump pins 1 and 2 to permit use of ADC serial inputs on P1 B-row.

E4: Channel 1 Flag Source Select

Jump pins 1 and 2 to use input flags from J4 PMAC2-style connector.
Jump pins 2 and 3 to use input flags from P1 PMAC(1)-style connector.

E5: Channel 2 Flag Source Select

Jump pins 1 and 2 to use input flags from J4 PMAC2-style connector.
Jump pins 2 and 3 to use input flags from P1 PMAC(1)-style connector.

E6: Channel 3 Flag Source Select

Jump pins 1 and 2 to use input flags from J4 PMAC2-style connector.
Jump pins 2 and 3 to use input flags from P1 PMAC(1)-style connector.

E7: Channel 4 Flag Source Select

Jump pins 1 and 2 to use input flags from J4 PMAC2-style connector.
Jump pins 2 and 3 to use input flags from P1 PMAC(1)-style connector.

E17A: AENA1 Polarity Select (Option A only)

Remove jumper for high-true AENA1 signal on P1.
Jump pins 1 and 2 for low-true AENA1 signal on P1.

E17B: AENA2 Polarity Select (Option A only)

Remove jumper for high-true AENA2 signal on P1.
Jump pins 1 and 2 for low-true AENA2 signal on P1.

E17C: AENA3 Polarity Select (Option A only)

Remove jumper for high-true AENA3 signal on P1.
Jump pins 1 and 2 for low-true AENA3 signal on P1.

E17D: AENA4 Polarity Select (Option A only)

Remove jumper for high-true AENA4 signal on P1.
Jump pins 1 and 2 for low-true AENA4 signal on P1.

E87: Flag Return Voltage Control (Option A only)

Remove jumper to separate FRET from signal common (GND) on board. (Must supply external FRET: +12V to +24V for sinking flag drivers)

Jump pins 1 and 2 to tie FRET to signal common on board. (Must tie E90 1-2 and use sourcing flag drivers)

E90: Flag Return Source Control (Option A only)

Jump pins 1 and 2 to use FRET or GND (see E87) as flag return voltage.
Jump pins 2 and 3 to use analog A+15V supply as flag return voltage.
(Must use sinking flag drivers)

E101: AENA/EQU Sinking/Sourcing Output Select (Option A only)

CAUTION:

Wrong jumper setting will damage IC.

Jump pins 1 and 2 for ULN2803A sinking driver IC in U2 for AENA & EQU.
Jump pins 2 and 3 for UDN2981A sourcing driver IC in U2 for AENA & EQU.

E102: AENA/EQU Sinking/Sourcing Output Select (Option A only)

CAUTION:

Wrong jumper setting will damage IC.

Jump pins 1 and 2 for ULN2803A sinking driver IC in U2 for AENA & EQU.
Jump pins 2 and 3 for UDN2981A sourcing driver IC in U2 for AENA & EQU.

E111: Channel 1 Output Signal Disable Control

Jump pins 1 and 2 to tri-state digital command output signals on amplifier disable.
Remove jumper to leave active zero-value digital command output signals on amplifier disable.

E112: Channel 2 Output Signal Disable Control

Jump pins 1 and 2 to tri-state digital command output signals on amplifier disable.
Remove jumper to leave active zero-value digital command output signals on amplifier disable.

E113: Channel 3 Output Signal Disable Control

Jump pins 1 and 2 to tri-state digital command output signals on amplifier disable.
Remove jumper to leave active zero-value digital command output signals on amplifier disable.

E114: Channel 4 Output Signal Disable Control

Jump pins 1 and 2 to tri-state digital command output signals on amplifier disable.
Remove jumper to leave active zero-value digital command output signals on amplifier disable.

ACC-2E OUTPUT MODE

The ACC-2E has three modes of outputs which are setup by either the TURBO UMAC or the MACRO CPU. The output modes available for the ACC-2E are Direct PWM, DAC, or PFM.

UMAC Turbo Outputs

To setup the output mode for the UMAC Turbo the user must set I7mn6 to the proper value. The Gate Array on the ACC-2E has three outputs per channel as shown below:

I7mn6 Setting	A Output	B Output	C Output
I7mn6=0	PWM	PWM	PWM
I7mn6=1	DAC	DAC	PWM
I7mn6=2	PWM	PWM	PFM
I7mn6=3	DAC	DAC	PFM

Direct PWM Mode for UMAC Turbo

To setup Direct PWM outputs the user will set I7mn6 equal to zero. Direct PWM outputs would typically be used with the Delta Tau ACC-8F. The PMAC2 gate array on the ACC-2E would put the A, B, and C outputs into PWM mode. Typical settings for direct PWM outputs are shown below.

Channel	Setting		Channel	Setting
1	I7016=0		5	I7116=0
2	I7026=0		6	I7126=0
3	I7036=0		7	I7136=0
4	I7046=0		8	I7146=0

DAC Output Mode for UMAC Turbo

To setup Direct PWM outputs the user will set I7mn6 equal to one or three. DAC outputs would typically be used with the ACC-2E Option 1A or the Delta Tau ACC-8A or ACC-8E**.** The PMAC2 gate array on the ACC-2E would put the A and B outputs into DAC mode. Typical settings for direct DAC outputs are shown below.

Channel	Setting		Channel	Setting
1	I7016=3		5	I7116=3
2	I7026=3		6	I7126=3
3	I7036=3		7	I7136=3
4	I7046=3		8	I7146=3

When used with the ACC-2E Option1A the user must modify the DAC strobe word for proper operation. The DAC Strobe word must set to $7FFF0 for 16-bit DACs on the ACC-2E option 1A. The default setting for the DAC Strobe word is for 18-bit operation.

ACC-2E Option 1A			ACC-8E or ACC-8A	
Channels	**Setting**		**Channels**	**Setting**
1-4	I7005=$7FFF00		1-4	I7005=$7FFFC0
5-8	I7105=$7FFF00		5-8	I7105=$7FFFC0

PFM Output Mode for UMAC Turbo

To setup Direct PWM outputs the user will set I7mn6 equal to two or three. DAC outputs would typically be used with the Delta Tau ACC-8S. The PMAC2 gate array on the ACC-2E would put the C output into PFM mode. Typical settings for direct DAC outputs are shown below.

Channel	Setting		Channel	Setting
1	I7016=3		5	I7116=3
2	I7026=3		6	I7126=3
3	I7036=3		7	I7136=3
4	I7046=3		8	I7146=3

MACRO Outputs

To setup the output mode for the MACRO the user must set MSn,MI916 to the proper value. The Gate Array on the ACC-2E has three outputs per channel as shown below:

MI916 Setting	A Output	B Output	C Output
MI916=0	PWM	PWM	PWM
MI916=1	DAC	DAC	PWM
MI916=2	PWM	PWM	PFM
MI916=3	DAC	DAC	PFM

Direct PWM Mode for MACRO

To setup Direct PWM outputs the user will set MI916 equal to zero. Direct PWM outputs would typically be used with the Delta Tau ACC-8F. The PMAC2 gate array on the ACC-2E would put the A, B, and C outputs into PWM mode. Typical settings for direct PWM outputs are shown below.

Channel	Setting		Channel	Setting
1	MS0,MI916=0		5	MS8,MI916=0
2	MS1,MI916=0		6	MS9,MI916=0
3	MS4,MI916=0		7	MS12,MI916=0
4	MS5,MI916=0		8	MS13,MI916=0

DAC Output Mode for MACRO

To setup Direct PWM outputs the user will set MI916 equal to one or three. DAC outputs would typically be used with the ACC-2E Option 1A or the Delta Tau ACC-8A or ACC-8E**.** The PMAC2 gate array on the ACC-2E would put the A and B outputs into DAC mode. Typical settings for direct DAC outputs are shown below.

Channel	Setting		Channel	Setting
1	MS0,MI916=3		5	MS8,MI916=3
2	MS1,MI916=3		6	MS9,MI916=3
3	MS4,MI916=3		7	MS12,MI916=3
4	MS5,MI916=3		8	MS13,MI916=3

Depending on the type of interface card the user is using for their DAC ouputs, the DAC strobe word might have to be modified for proper operation. The DAC Strobe word must set to $7FFF00 for 16-bit DACs on the ACC-1E option 1A (default) and it must be set to $7FFFC0 for 18-bit operation if used with the ACC-8E or ACC-8A.

ACC-2E Option 1A			**ACC-8E or ACC-8A**	
Channels	**Setting**		**Channels**	**Setting**
1-4	MS0,MI905=$7FFF00		1-4	MS0,MI905=$7FFFC0
5-8	MS0,MI909=$7FFF00		5-8	MS0,MI909=$7FFFC0

PFM Output Mode for MACRO

To setup Direct PWM outputs the user will set MI916 equal to two or three. DAC outputs would typically be used with the Delta Tau ACC-8S. The PMAC2 gate array on the ACC-2E would put the C output into PFM mode. Typical settings for direct DAC outputs are shown below.

Channel	**Setting**
1	MS0,MI916=3
2	MS1,MI916=3
3	MS4,MI916=3
4	MS5,MI916=3

Channel	**Setting**
5	MS8,MI916=3
6	MS9,MI916=3
7	MS12,MI916=3
8	MS13,MI916=3

ENCODER LOSS FEATURE

Many newer PMAC and UMAC systems have dedicated circuitry for the detection of the loss of incremental encoder feedback. However, there is presently no dedicated firmware function to take action when loss of encoder is detected.

Principle of Operation

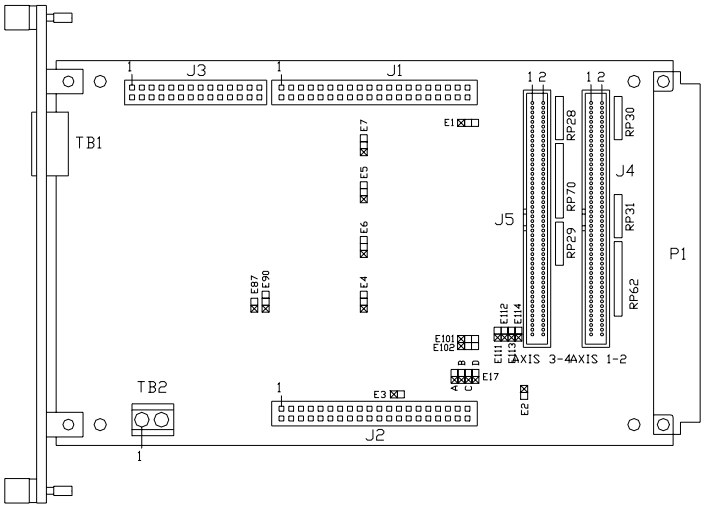
The encoder-loss detection circuitry works only for differential incremental encoders. In proper operation, the digital states of the complementary inputs for a channel (e.g. A and A/) should always be opposite: when one is high, the other is low. If for some reason, such as a cable connection coming undone, one or more of the signal lines is no longer driven, pull-up resistors on the input line pull and hold the signal high.

The encoder-loss detection circuitry uses "exclusive-or" (XOR) gates on each complementary pair to detect whether the signals are in the same or opposite states. These results are combined to produce a single "encoder-loss" status bit that the processor can read.

In order to enable this function, the socketed resistor packs for the encoder must be reversed from their factory default setting so that the complementary encoder lines A/, B/, and C/ are pulled up to 5V instead of pulled to 2.5V. The resistor packs to be reversed are RP28, RP29, RP30, and RP31.

RP30 – Channel 1
RP31 – Channel 2
RP28 – Channel 3
RP29 – Channel 4

The resistor packs are located near the JMACH connectors on the ACC-2E and the ACC-1E as shown in the diagram below.



UMAC Turbo Encoder Loss Detection

ACC-2E Discrete On-board Logic with UMAC Turbo CPU

Channel	Resistor Pack	Status Bit Address*	Status Bit "Name"	Bit Error State
1	RP30	Y:$078403,8	CTRL0	0
2	RP31	Y:$078403,9	CTRL1	0
3	RP28	Y:$078403,10	CTRL2	0
4	RP29	Y:$078403,11	CTRL3	0

Note

These addresses are shared by both ACC-2E boards that can be in a system, and the first two are shared with any ACC-1E in the system.

To detect the errors with the UMAC Turbo system the user must read the status bit registers described in the table above.

MACRO Station Encoder Loss Detection

To detect the encoder loss with the MACRO-Station, the user must set **`MSn,MI7=1`** and monitor the encoder error detection bit at the MACRO-Station. To monitor the status of the encoder error detection bit, the user must monitor **`MSn,MI4`**. **`MSn,MI4`** monitors several important MACRO Station status bits as described in the MACRO Software reference. To monitor the encoder loss, the user must query the MI4 variable either in a PLC or with online commands. When any axis has an encoder loss, then bit 5 of **`MSn,MI4`** is set to 1. The encoder which failed can be determined by reading bits 8 through 11.

MSn, MI4

Bit #	Fault	Notes
0	CPU Fault	
1	Ring Communications Error	
2	Ring Break Detected	
3	Station Fault	
4	Ring Fault	
5	Encoder-Loss Fault	
6	Amplifier Fault	
7	Ring Break Notification Received	
8	Encoder 1 or 5 Loss Fault	
9	Encoder 2 or 6 Loss Fault	
10	Encoder 3 or 7 Loss Fault	
11	Encoder 4 or 8 Loss Fault	
12	Ring Active	
13	Multiplexer Port Parity Error	From ACC-34 board with parity checking
13-23	(Reserved for future use)	

Example:
(a) MS0, MI7=1 ;enable encoder loss detection
(b) Read MS0, MI4

To process the data in a PLC or online the user could do the following:
`MSR,MI4,P1000` ;copies value of MI4 into P1000

To Read bit 5 of MS0, MI4
```
P800=P1000&$0020/$20   ;if P800=1, we have an encoder loss at the MACRO Station
```

To Read bit 8 of MS0, MI4
```
P801=P1000&$0100/$100  ;if P801=1, we have an encoder loss on encoder 1 or 5
```

To Read bit 9 of MS0, MI4
```
P802=P1000&$0200/$200  ;if P802=1, we have an encoder loss on encoder 2 or 6
```

To Read bit 10 of MS0, MI4
```
P803=P1000&$0400/$400  ;if P803=1, we have an encoder loss on encoder 3 or 7
```

To Read bit 11 of MS0, MI4
```
P804=P1000&$0800/$800  ;if P804=1, we have an encoder loss on encoder 4 or 8
```

When a loss of encoder is detected, the MACRO-Station will display an "**E**".

ACC-2E 4-AXIS PIGGYBACK BOARD CONNECTOR DESCRIPTION

J1-J3 (JEXP_A - JEXP_C) (For Interboard Connection)

(Consult factory if pinout information needed.)

J4 (JMACH1-DIG) PMAC2-Style Axis Interface Connector Description

Pin#	Symbol	Function	Description	Notes
1	+5V	Output/Input	+5V Power	For external circuit or from external supply
2	+5V	Output/Input	+5V Power	For external circuit or from external supply
3	GND	Common	Reference Voltage	
4	GND	Common	Reference Voltage	
5	CHA1+	Input	Encoder 1 Positive A Channel	Also pulse input
6	CHA1-	Input	Encoder 1 Negative A Channel	Also pulse input
7	CHB1+	Input	Encoder 1 Positive B Channel	Also direction input
8	CHB1-	Input	Encoder 1 Negative B Channel	Also direction input
9	CHC1+	Input	Encoder 1 Positive C Channel	Index channel
10	CHC1-	Input	Encoder 1 Negative C Channel	Index channel
11	CHU1	Input	Channel 1 U Flag	Hall Effect, Fault Code, or sub-count
12	CHV1	Input	Channel 1 V Flag	Hall Effect, Fault Code, or sub-count
13	CHW1	Input	Channel 1 W Flag	Hall Effect, Fault Code, or sub-count
14	CHT1	Input	Channel 1 T Flag	Fault Code, or sub-count
15	USER1	Input	General Purpose User Flag	Hardware capture flag, or sub-count
16	PLIM1	Input	Positive Overtravel Limit	Hardware capture flag
17	MLIM1	Input	Negative Overtravel Limit	Hardware capture flag
18	HOME1	Input	Home Switch Input	Hardware capture flag
19	ACCFLT1	Input	Accessory Fault Flag	For loss of ACC supply voltage
20	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
21	SCLK12+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
22	SCLK12-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
23	ADC_CLK1+	Output	A/D Converter Clock	Programmable frequency
24	ADC_CLK1-	Output	A/D Converter Clock	Programmable frequency
25	ADC_STB1+	Output	A/D Converter Strobe	Programmable sequence
26	ADC_STB1-	Output	A/D Converter Strobe	Programmable sequence
27	ADC_DAA1+	Input	Channel A ADC Serial Data	MSB first
28	ADC_DAA1-	Input	Channel A ADC Serial Data	MSB first

J4 (JMACH1-DIG) PMAC2-Style Axis Interface Connector Description (Cont.)

Pin#	Symbol	Function	Description	Notes
29	ADC_DAB1+	Input	Channel B ADC Serial Data	MSB first
30	ADC_DAB1-	Input	Channel B ADC Serial Data	MSB first
31	AENA1+	Output	Amplifier Enable	High is enable
32	AENA1-	Output	Amplifier Enable	Low is enable
33	FAULT1+	Input	Amplifier Fault	Programmable polarity
34	FAULT1-	Input	Amplifier Fault	Programmable polarity
35	PWMATOP1+ DAC_CLK1+	Output	Phase A Top CMD or DAC Clock	Programmable function control
36	PWMATOP1- DAC_CLK1-	Output	Phase A Top CMD or DAC Clock	Programmable function control
37	PWMABOT1+ DAC1A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
38	PWMABOT1- DAC1A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
39	PWMBTOP1+ DAC_STB1+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
40	PWMBTOP1- DAC_STB1-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
41	PWMBBOT1+ DAC1B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
42	PWMBBOT1- DAC1B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
43	PWMCTOP1+ DIR1+	Output	Phase B Top CMD or PFM Direction	Programmable function control
44	PWMCTOP1- DIR1-	Output	Phase B Top CMD or PFM Direction	Programmable function control
45	PWMCBOT1+ PULSE1+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
46	PWMCBOT1- PULSE1-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
47	GND	Common	Reference Voltage	
48	GND	Common	Reference Voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference Voltage	
54	GND	Common	Reference Voltage	
55	CHA2+	Input	Encoder 2 Positive A Channel	Also Pulse input
56	CHA2-	Input	Encoder 2 Negative A Channel	Also Pulse input
57	CHB2+	Input	Encoder 2 Positive B Channel	Also direction input
58	CHB2-	Input	Encoder 2 Neg. B Channel	Also direction input
59	CHC2+	Input	Encoder 2 Positive C Channel	Index channel
60	CHC2-	Input	Encoder 2 Neg. C Channel	Index channel

J4 (JMACH1-DIG) PMAC2-Style Axis Interface Connector Description (Cont.)

Pin#	Symbol	Function	Description	Notes
61	CHU2	Input	Channel 2 U Flag	Hall Effect, Fault Code, or SUB-count
62	CHV2	Input	Channel 2 V Flag	Hall EFFECT, Fault Code, or sub-count
63	CHW2	Input	Channel 2 W Flag	Hall EFFECT, Fault Code, or sub-count
64	CHT2	Input	Channel 2 T Flag	Fault Code, or sub-count
65	USER2	Input	General Purpose User Flag	Hardware capture flag, or sub-count
66	PLIM2	Input	Positive Overtravel Limit	Hardware capture flag
67	MLIM2	Input	Negative Overtravel Limit	Hardware capture flag
68	HOME2	Input	Home Switch Input	Hardware capture flag
69	ACCFLT2	Input	Accessory Fault Flag	For loss of Acc supply voltage
70	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
71	SCLK12+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
72	SCLK12-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
73	ADC_CLK2+	Output	A/D Converter Clock	Programmable frequency
74	ADC_CLK2-	Output	A/D Converter Clock	Programmable frequency
75	ADC_STB2+	Output	A/D Converter Strobe	Programmable sequence
76	ADC_STB2-	Output	A/D Converter Strobe	Programmable sequence
77	ADC_DAA2+	Input	Channel A ADC Serial Data	MSB first
78	ADC_DAA2-	Input	Channel A ADC Serial Data	MSB first
79	ADC_DAB2+	Input	Channel B ADC Serial Data	MSB first
80	ADC_DAB2-	Input	Channel B ADC Serial Data	MSB first
81	AENA2+	Output	Amplifier Enable	High is enable
82	AENA2-	Output	Amplifier Enable	Low is enable
83	FAULT2+	Input	Amplifier Fault	Programmable polarity
84	FAULT2-	Input	Amplifier Fault	Programmable polarity
85	PWMATOP2+ DAC_CLK2+	Output	Phase A Top CMD or DAC Clock	Programmable function control
86	PWMATOP2- DAC_CLK2-	Output	Phase A Top CMD or DAC Clock	Programmable function control
87	PWMABOT2+ DAC2A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
88	PWMABOT2- DAC2A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
89	PWMBTOP2+ DAC_STB2+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
90	PWMBTOP2- DAC_STB2-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
91	PWMBBOT2+ DAC2B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
92	PWMBBOT2- DAC2B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control

J4 (JMACH1-DIG) PMAC2-Style Axis Interface Connector Description (Cont.)

Pin#	Symbol	Function	Description	Notes
93	PWMCTOP2+ DIR2+	Output	Phase B Top CMD or PFM Direction	Programmable function control
94	PWMCTOP2- DIR2-	Output	Phase B Top CMD or PFM Direction	Programmable function control
95	PWMCBOT2+ PULSE2+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
96	PWMCBOT2- PULSE2-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
97	GND	Common	Reference Voltage	
98	GND	Common	Reference Voltage	
99	+5V	Output/Input	+5V Power	For external circuit or from external supply
100	+5V	Output/Input	+5V Power	For external circuit or from external supply
The JMACH1 connector provides the interface pins for channels 1 and 2. It is usually connected to a breakout board, such as one of the ACC-8x family of boards, or an application-specific interface board. Connector: 100-pin male box header with center key, 0.050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00100-FPB.				

J5 (JMACH2-DIG) PMAC2-Style Axis Interface Connector Description

Pin#	Symbol	Function	Description	Notes
1	+5V	Output/Input	+5V Power	For external circuit or from external supply
2	+5V	Output/Input	+5V Power	For external circuit or from external supply
3	GND	Common	Reference Voltage	
4	GND	Common	Reference Voltage	
5	CHA3+	Input	Encoder 3 Positive A Channel	Also pulse input
6	CHA3-	Input	Encoder 3 Negative A Channel	Also pulse input
7	CHB3+	Input	Encoder 3 Positive B Channel	Also direction input
8	CHB3-	Input	Encoder 3 Negative B Channel	Also direction input
9	CHC3+	Input	Encoder 3 Positive C Channel	Index channel
10	CHC3-	Input	Encoder 3 Negative C Channel	Index channel
11	CHU3	Input	Channel 3 U Flag	Hall Effect, Fault Code, or SUB-count
12	CHV3	Input	Channel 3 V Flag	Hall Effect, Fault Code, or SUB-count
13	CHW3	Input	Channel 3 W Flag	Hall Effect, Fault Code, or SUB-count
14	CHT3	Input	Channel 3 T Flag	Fault Code, or sub-count
15	USER3	Output	General Purpose User Flag	Hardware capture flag, or sub-count
16	PLIM3	Output	Positive Overtravel Limit	Hardware capture flag
17	MLIM3	Output	Negative Overtravel Limit	Hardware capture flag
18	HOME3	Output	Home Switch Input	Hardware capture flag
19	ACCFLT3	Output	Accessory Fault Flag	For loss of Acc supply voltage
20	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
21	SCLK34+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
22	SCLK34-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
23	ADC_CLK3+	Output	Encoder Sample Clock	Programmable frequency
24	ADC_CLK3-	Output	Encoder Sample Clock	Programmable frequency
25	ADC_STB3+	Output	Encoder Sample Strobe	Programmable sequence
26	ADC_STB3-	Output	Encoder Sample Strobe	Programmable sequence
27	ADC_DAA3+	Input	Channel A ADC Serial Data	MSB first
28	ADC_DAA3-	Input	Channel A ADC Serial Data	MSB first
29	ADC_DAB3+	Input	Channel B ADC Serial Data	MSB first
30	ADC_DAB3-	Input	Channel B ADC Serial Data	MSB first
31	AENA3+	Output	Amplifier Enable	High is enable
32	AENA3-	Output	Amplifier Enable	Low is enable
33	FAULT3+	Input	Amplifier Fault	Programmable polarity
34	FAULT3-	Input	Amplifier Fault	Programmable polarity

J5 (JMACH2-DIG) PMAC2-Style Axis Interface Connector Description (Cont.)

Pin#	Symbol	Function	Description	Notes
35	PWMATOP3+ DAC_CLK3+	Output	Phase A Top CMD or DAC Clock	Programmable function control
36	PWMATOP3- DAC_CLK3-	Output	Phase A Top CMD or DAC Clock	Programmable function control
37	PWMABOT3+ DAC3A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
38	PWMABOT3- DAC3A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
39	PWMBTOP3+ DAC_STB3+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
40	PWMBTOP3- DAC_STB3-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
41	PWMBBOT3+ DAC3B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
42	PWMBBOT3- DAC3B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
43	PWMCTOP3+ DIR3+	Output	Phase B Top CMD or PFM Direction	Programmable function control
44	PWMCTOP3- DIR3-	Output	Phase B Top CMD or PFM Direction	Programmable function control
45	PWMCBOT3+ PULSE3+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
46	PWMCBOT3- PULSE3-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
47	GND	Common	Reference Voltage	
48	GND	Common	Reference Voltage	
49	+5V	Output/Input	+5V Power	For external circuit or from external supply
50	+5V	Output/Input	+5V Power	For external circuit or from external supply
51	+5V	Output/Input	+5V Power	For external circuit or from external supply
52	+5V	Output/Input	+5V Power	For external circuit or from external supply
53	GND	Common	Reference Voltage	
54	GND	Common	Reference Voltage	
55	CHA4+	Input	Encoder 4 Positive A Channel	Also Pulse input
56	CHA4-	Input	Encoder 4 Negative A Channel	Also Pulse input
57	CHB4+	Input	Encoder 4 Positive B Channel	Also direction input
58	CHB4-	Input	Encoder 4 Negative B Channel	Also direction input
59	CHC4+	Input	Encoder 4 Positive C Channel	Index channel
60	CHC4-	Input	Encoder 4 Negative C Channel	Index channel
61	CHU4	Input	Channel 4 U Flag	Hall Effect, Fault Code, or sub-count

J5 (JMACH2-DIG) PMAC2-Style Axis Interface Connector Description (Cont.)

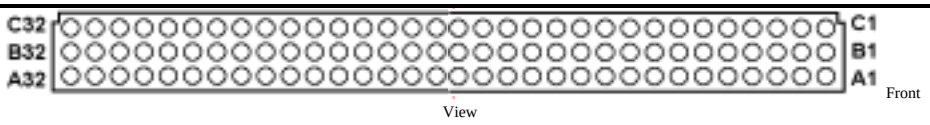
Pin#	Symbol	Function	Description	Notes
62	CHV4	Input	Channel 4 v Flag	Hall Effect, Fault Code, or sub-count
63	CHW4	Input	Channel 4 w Flag	Hall Effect, Fault Code, or sub-count
64	CHT4	Input	Channel 4 t Flag	Fault Code, or sub-count
65	USER4	Input	General Purpose User Flag	Hardware capture flag, or sub-count
66	PLIM4	Input	Positive Overtravel Limit	Hardware capture flag
67	MLIM4	Input	Negative Overtravel Limit	Hardware capture flag
68	HOME4	Input	Home Switch Input	Hardware capture flag
69	ACCFLT4	Input	Accessory Fault Flag	For loss of Acc supply voltage
70	WD0/	Output	Watchdog Output	Low is PMAC watchdog fault
71	SCLK34+	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
72	SCLK34-	Input/Output	Encoder Sample Clock	Direction controlled by PMAC2 jumper
73	ADC_CLK4+	Output	A/D Converter Clock	Programmable frequency
74	ADC_CLK4-	Output	A/D Converter Clock	Programmable frequency
75	ADC_STB4+	Output	A/D Converter Strobe	Programmable sequence
76	ADC_STB4-	Output	A/D Converter Strobe	Programmable sequence
77	ADC_DAA4+	Input	Channel A ADC Serial Data	MSB first
78	ADC_DAA4-	Input	Channel A ADC Serial Data	MSB first
79	ADC_DAB4+	Input	Channel B ADC Serial Data	MSB first
80	ADC_DAB4-	Input	Channel B ADC Serial Data	MSB first
81	AENA4+	Output	Amplifier Enable	High is enable
82	AENA4-	Output	Amplifier Enable	Low is enable
83	FAULT4+	Input	Amplifier Fault	Programmable polarity
84	FAULT4-	Input	Amplifier Fault	Programmable polarity
85	PWMATOP4+ DAC_CLK4+	Output	Phase A Top CMD or DAC Clock	Programmable function control
86	PWMATOP4- DAC_CLK4-	Output	Phase A Top CMD or DAC Clock	Programmable function control
87	PWMABOT4+ DAC4A+	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
88	PWMABOT4- DAC4A-	Output	Phase A Bottom CMD or DAC A Serial Data	Programmable function control
89	PWMBTOP4+ DAC_STB4+	Output	Phase B Top CMD or DAC Strobe	Programmable function control
90	PWMBTOP4- DAC_STB4-	Output	Phase B Top CMD or DAC Strobe	Programmable function control
91	PWMBBOT4+ DAC4B+	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control

J5 (JMACH2-DIG) PMAC2-Style Axis Interface Connector Description (Cont.)

Pin#	Symbol	Function	Description	Notes
92	PWMBBOT4- DAC4B-	Output	Phase B Bottom CMD or DAC B Serial Data	Programmable function control
93	PWMCTOP4+ DIR4+	Output	Phase B Top CMD or PFM Direction	Programmable function control
94	PWMCTOP4- DIR4-	Output	Phase B Top CMD or PFM Direction	Programmable function control
95	PWMCBOT4+ PULSE4+	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
96	PWMCBOT4- PULSE4-	Output	Phase B Bottom CMD or PFM Pulse	Programmable function control
97	GND	Common	Reference Voltage	
98	GND	Common	Reference Voltage	
99	+5V	Output/Input	+5V Power	For external circuit or from external supply
100	+5V	Output/Input	+5V Power	For external circuit or from external supply
The JMACH2 connector provides the interface pins for channels 3 and 4. It is usually connected to a breakout board, such as one of the ACC-8x family of boards, or an application-specific interface board. Connector: 100-pin male box header with center key, 0.050" pitch. AMP part # 1-04068-7 Delta Tau part # 014-00100-FPB.				

P1 (JMACH-ANA) PMAC(1)-Style Axis Interface Connector Description

P1 JMACH-ANA (96-Pin Header)



Pin #	Symbol	Function	Description	Notes
A01	+5V*	Output	+5V Power	For encoders
A02	GND	Common	Digital Common	
A03	CHC4	Input	Encoder C Channel Positive	
A04	CHC4/	Input	Encoder C Channel Negative	Do not ground if not used
A05	CHB4	Input	Encoder B Channel Positive	
A06	CHB4/	Input	Encoder B Channel Negative	Do not ground if not used
A07	CHA4	Input	Encoder A Channel Positive	
A08	CHA4/	Input	Encoder A Channel Negative	Do not ground if not used
A09	CHC2	Input	Encoder C Channel Positive	
A10	CHC2/	Input	Encoder C Channel Negative	Do not ground if not used
A11	CHB2	Input	Encoder B Channel Positive	
A12	CHB2/	Input	Encoder B Channel Negative	Do not ground if not used
A13	CHA2	Input	Encoder A Channel Positive	
A14	CHA2/	Input	Encoder A Channel Negative	Do not ground if not used
A15	DAC4	Output	Analog Out Positive 4	+/-10V to GND
A16	DAC4/	Output	Analog Out Negative 4	+/-10V to GND
A17	AENA4/DIR4	Output	AMP-ENA/DIR. 4	Jumperable polarity (E17D)
A18	FAULT4	Input	AMP-Fault 4	Programmable polarity
A19	MLIM4 **	Input	Negative End Limit 4	Failsafe high true
A20	PLIM4 **	Input	Positive End Limit 4	Failsafe high true
A21	HMFL4	Input	Home-Flag 4	Programmable polarity
A22	DAC2	Output	Analog Out Pos. 2	+/-10V TO GND
A23	DAC2/	Output	Analog Out Neg. 2	+/-10V TO GND
A24	AENA2/DIR2	Output	AMP-ENA/DIR. 2	Jumperable polarity (E17B)
A25	FAULT2	Input	AMP-Fault 2	Programmable polarity
A26	MLIM2 **	Input	Negative End Limit 2	Failsafe high true
A27	PLIM2 **	Input	Positive End Limit 2	Failsafe high true
A28	HMFL2	Input	Home-Flag 2	Programmable polarity
A29	FRET	RETURN	Flag Return	See E87, E90
A30	A-15V	INPUT	Analog -15V Supply	
A31	GND	COMMON	Digital Common	
A32	+5V*	OUTPUT	+5V Power	For encoders

P1 JMACH-ANA (96-Pin Header)

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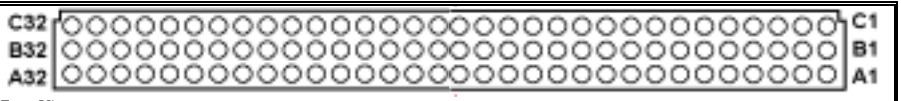

Front View

Pin #	Symbol	Function	Description	Notes
B01	+5V*	Output	+5V Power	For encoders
B02	GND	Common	Digital Common	
B03	DIR1+	Output	PFM Direction	(1)
B04	DIR1-	Output	PFM Direction	(1)
B05	PUL1+	Output	PFM Pulse	(1)
B06	PUL1-	Output	PFM Pulse	(1)
B07	USER1+	Input		
B08	DIR2+	Output	PFM Direction	(1)
B09	DIR2-	Output	PFM Direction	(1)
B10	PUL2+	Output	PFM Pulse	(1)
B11	PUL2-	Output	PFM Pulse	(1)
B12	USER2+	Input	User Capture Flag	
B13	HWA1+	Input	Supp. Encoder A Ch.	(2)
B14	HWA1-	Input	Supp. Encoder A Ch.	(2)
B15	HWB1+	Input	Supp. Encoder B Ch.	(2)
B16	HWB1-	Input	Supp. Encoder B Ch.	(2)
B17	HWA2+	Input	Supp. Encoder A Ch.	(2)
B18	HWA2-	Input	Supp. Encoder A Ch.	(2)
B19	HWB2+	Input	Supp. Encoder B Ch.	(2)
B20	HWB2-	Input	Supp. Encoder B Ch.	(2)
B21	EQU1	Output	Position Compare Flag	Programmable polarity
B22	EQU2	Output	Position Compare Flag	Programmable polarity
B23	EQU3	Output	Position Compare Flag	Programmable polarity
B24	EQU4	Output	Position Compare Flag	Programmable polarity
B25	DCLK	Output	A/D Converter Clock	For Acc-28B (3)
B26	CNVRT	Output	A/D Converter Strobe	For Acc-28B (3)
B27	ADC1	Input	ADC Serial Data	For Acc-28B (3)
B28	ADC2	Input	ADC Serial Data	For Acc-28B (3)
B29	ADC3	Output	ADC Serial Data	For Acc-28B (3)
B30	ADC4	Input	ADC Serial Data	For Acc-28B (3)
B31	GND	Common	Digital Common	
B32	+5V*	Output	+5V Power	

The “B” row of P1 on the 4-axis piggyback board brings out extra signals for alternate connection of some signals

(1) The pulse and direction outputs here provide outputs that are normally brought out on the 2-axis piggyback board. These signals are generated on the CPU/Interface Board and can be used here even if the 2-axis board is not present. Software setup of the MACRO Station should then be as if the 2-axis board was present.

(2) The encoder inputs here provide connections that are normally brought in on the 2-axis piggyback board. These signals are processed on the CPU/Interface Board. They can be brought in here only if jumper E2 on this board is ON, and no 2-axis board is present.

(3) The ACC-28B interface provided here provides connections that are normally made on the 2-axis piggyback board. These signals are processed on the CPU/Interface Board. The connection can be made here only if jumper E3 on this board is OFF, and no 2-axis board is present.

P1 JMACH-ANA (96-Pin Header)

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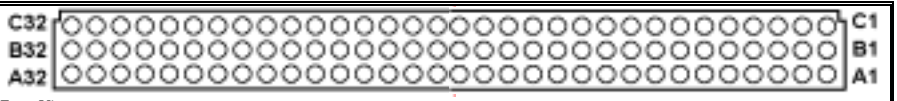


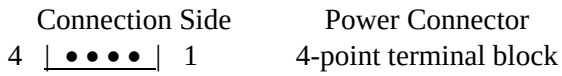
Front View

Pin #	Symbol			
C01	+5V*			
C02	GND			
C03	CHC3			
C04	CHC3/			
C05	CHB3			
C06	CHB3/			
C07	CHA3			
C08	CHA3/			
C09	CHC1			
C10	CHC1/			
C11	CHB1			
C12	CHB1/			
C13	CHA1			
C14	CHA1/			
C15	DAC3			
C16	DAC3/			
C17	AENA3/DIR3			
C18	FAULT3			
C19	MLIM3 **			
C20	PLIM3 **			
C21	HMFL3			
C22	DAC1			
C23	DAC1/			
C24	AENA1/DIR1			
C25	FAULT1			
C26	MLIM1 **			
C27	PLIM1 **			
C28	HMFL1			
C29	FEFCO/			
C30	A+15V			
C31	GND			
C32	+5V*			

The P1 connector is used to connect the Compact MACRO Station to 4 channels of servo amps, flags, and encoders.

TB1 (4-Point Terminal Block)

Pin #	Symbol			
1	GND	Common	Reference Voltage	
2	+5V	Input	Positive Supply Voltage	Supplies all digital circuits
3	+15V	Input	Positive Supply Voltage	+12V to +15V; required for Opt 1B, Opt 4; can be used for flag power
4	-15V	Input	Positive Supply Voltage	-12V to -15V; required for Opt 1B, Opt 4; can be used for flag power



TB2 (4-Pin Terminal Block)

This terminal block provides the output for the Compact MACRO Station's watchdog timer relay, both normally open and normally closed contacts.

Pin #	Symbol			
1	WD_NC	Output	Watchdog Relay Out	Normally closed
2	COM	Input	Watchdog Return	+V or 0V
3	WD_NO	Output	Watchdog Relay Out	Normally open
4	COM	Input	Watchdog Return	+V or 0V
Note: The "normally closed" relay contact is open while the Compact MACRO Station s operating properly -- it has power and the watchdog timer is not tripped -- and closed when the Compact MACRO Station is not operating properly -- either it has lost power or the watchdog timer has tripped. The "normally open" relay contact is closed while Compact MACRO Station is operating properly, and open when the Compact MACRO Station is not operating properly.